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FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

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United States of America

INTEGRATED RIVER BASIN DEVELOPMENT AND INDUSTRIALIZATION : THE TENNESSEE VALLEY EXPERIENCE

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INTEGRATED RIVER BASIN DEVELOPMENT AND INDUSTRIALIZATION: THE TENNESSEE VALLEY EXPERIENCE

by
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1. The integrated river basin development experiment of the Tennessee Valley Authority (TVA), now in its 30th year, can provide valuable guidance for the industrialization efforts of the less developed areas.
2. During the next 40 or 50 years, several hundred billion dollars will be invested in integrated river basin projects throughout the world, according to a recent estimate by a panel of United Nations' experts.[1] At present, more than thirty-four countries are using portions of the TVA experience in valley development schemes such as the Damodar in India, the San Francisco in Brazil, and the Volta River in Ghana.[2] And in virtually all of these projects, industrialization is expected to be one of the major results.

River Basin Development and Industrialization: General Theory

3. What is the causal relationship between integrated river basin projects and industrialization? One basic characteristic of such programs is that they are only a partial approach to the development of a region. A comprehensive development effort to raise levels of production, employment and income in an area would include many governmental and non-governmental programs which are normally outside the scope of an integrated river basin project. The TVA, for example, is erroneously considered to have broad authority in its area. But it has no direct control over many activities necessarily involved in a full development program such as taxes, fiscal policies, transportation rates and policies, agricultural policy, tariffs and foreign trade, public investment in roads, schools, hospitals and educational policies. The only legal powers granted to the TVA are the right of eminent domain, the right to spend available funds and, recently, the right to raise investment funds through the sale of bonds.
4. In TVA's region, other Federal agencies continue to operate programs and exercise their authority in all customary fields on the basis of national policies, which may or may not be consistent with the objectives of the regional project. State and local governments in the Valley region also continue to exercise virtually all of their customary powers. The TVA Act (Sections 22 and 23) does provide, however, for an indirect advisory approach through studies and surveys for harmonizing the Valley's programs with other governmental activities. TVA's limited authority can be explained by special historical, political and other features of the American scene. And river basin projects in other countries are generally endowed with a different degree and mix of legal authority. But because river basin projects do not conform to the boundaries of already existing political units, the normal pattern throughout the world is to vest only limited authority in river basin agencies.
5. A second basic characteristic of river basin projects is that their main influence is on the physical supply and cost conditions of certain resources in the region. The rate at which the improved resource situation is translated into new and expanded industrial activity will depend upon demand factors usually outside the control of the

river basin project. A successful program can improve the physical availability of hydro-electric power, forest products, industrial water, agricultural materials and water transportation and thereby increase the potential for industrialization. But improved physical availability is not a sufficient condition for industrial development. Markets must exist for the specific resources being improved. Business entrepreneurship, government or private, must be active. And complementary policies and activities by other government and private agencies are essential. Furthermore, depending upon the locational characteristics of new enterprises, the industrialization stimulated by the improved resource situation may be most efficiently located outside of the valley region.

6. It might be argued that the large investments required for a river basin project and their multiplier effects will create a self-generating regional demand for resources. In a predominantly agricultural region, however, a large share of the direct impact of investment expenditures is likely to be outside of the basin and even outside of the country. In the case of low income areas, however, the share remaining in the region may still be significant in relation to total regional income or investment. From inception in 1933 to 1962 the TVA involved a total of more than $2 billion in new investment, of which less than 50 per cent went for goods and services supplied by the region. Over the 29 year period, the expenditures made by TVA in the region averaged less than two per cent of total personal income in the area.

7. The geography of the investment expenditure impact will depend upon the specific composition of the project and the productive facilities of the region and the country. Expenditures for construction labor and many services will generally mean increased income and employment in the region. But the substantial expenditures for generators, turbines and other electrical, mechanical and construction equipment will normally go to the developed regions or the foreign countries which produce this equipment. The expenditures for steel, cement, and other construction materials will have little immediate influence on regional demand unless these products are produced in the region. The limited "demand effect" in the region of most river basin projects is important to keep in mind. It emphasizes the importance of expanding only the type of resources for which a future demand will exist.

An Overview of Valley Economic Trends

8. The Tennessee Valley Region, including the watershed and power service area covers 92,000 square miles and has a population of about 6,200,000. The rough terrain coupled with abundant rainfall, averaging 52 inches per year, insures an outstanding supply of waterpower. But rugged topography and relatively poor quality soils limit the region's agricultural capacity even though rainfall and climate are favorable. More than half of the land area is in forests. And the region's mineral resources are generally of low quality and found in small deposits.

9. Three decades ago, the Tennessee Valley presented a somewhat typical picture of an economically underdeveloped region. The area was heavily populated and both human and physical resources were greatly underutilized. In fact, the region's most valuable physical resource -- abundant water -- was causing economic damage through flooding and erosion rather than making a positive contribution to economic welfare. Low productivity agriculture was the predominant source of employment and income. Underemployment was widespread and a critical need existed for utilizing more fully both natural and human resources through industrialization. Average per capita income in the Valley, even in the prosperity year of 1929, was only 45 per cent of the national average, $317 as compared to $703 per person in the nation as a whole.

10. The Shift from Agriculture to Industry: Since 1933 when the TVA was established, the Valley economy has grown at a faster rate than the nation and has shifted from a predominantly agricultural area to an important and expanding industrial region. By 1960, due both to rapid industrialization and extensive outmigration of surplus labor, income per capita in the Tennessee Valley reached a level of $1,378 or 64 per cent of the national average.

11. Agricultural trends in the Tennessee Valley generally followed the national patterns of sharp declines in farm employment and only modest gains in total farm income.

From 1930 to 1960, despite a steadily growing total labor force, the number of workers in Valley agriculture declined by 70 percent. Yet, over the same period, total farm income doubled. Income per farm worker gained greatly, of course, but still remained significantly below levels in the rest of the country. Due to below-average agricultural potentials and a less favorable impact of national agricultural programs on Valley agriculture as compared to other farm areas, the Valley's farming sector contributed little if any to the narrowing of the economic gap between the region and the rest of the country.

12. Industry, on the other hand, expanded more rapidly in the Tennessee Valley than in the nation as a whole or in the larger Southeast region. Manufacturing employment increased from 222,000 in 1929 to 486,000 in 1960, a gain of 119 per cent as compared to 55 per cent in the nation and 101 per cent in the Southeast. Manufacturing wages and salaries grew from $213 million in 1929 to $1.9 billion in 1960, an increase of 807 per cent as compared to 443 per cent in the Nation and 720 per cent in the Southeast. (The Southeast region includes the 11 states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Tennessee, South Carolina, and Virginia.)

13. The differential trends in agriculture and industry changed greatly the regional structure of economic activity. In 1930 about half of the Valley's employment was in agriculture as compared to 13 per cent in manufacturing. But by 1960, farm employment had dropped to 14 per cent of the total, while manufacturing jobs increased to 26 per cent. In other words, the ratio of farm to factory workers was four to one in 1930, but by 1960 farm workers were outnumbered by factory workers by a margin of almost two to one. As sources of regional income, the positions of agriculture and industry have also been reversed. In 1929 personal income from agriculture was almost twice as important as that from manufacturing. But by 1960 manufacturing was providing almost three times the income from agriculture. Industrial expansion, by providing an increasing number of relatively high income jobs for the region, greatly stimulated employment in the "tertiary" fields of trade, services, finance, etc. Trade and service employment expanded from about 560,000 in 1930 to about one million in 1960, an increase of 1.8 jobs in trade and services for each new manufacturing job.

14. The industrialization of the Tennessee Valley, an open economy within the larger Southeast region and the still larger national political unit, has been influenced, of course, by national policies and trends. For example, manufacturing employment in the United States expanded as much over the eight year period from 1939 to 1947 as over the prior 50 year period from 1889, and the Tennessee Valley shared in this expansion. Furthermore, the Southeast as a whole has in recent years attracted a large share of the nation's industrial expansion.[3]

15. Population and Migration Trends: The broad population, migration and employment patterns that accompanied rapid industrialization in the Tennessee Valley are extremely significant. Although the Valley's rate of natural increase in population (excess of births over deaths) has been consistently above that for the nation, population remaining in the Valley increased by only 24.5 per cent as compared to 45.6 per cent for the nation over the 30 year period, 1930 to 1960. Consequently, an estimated 1,500,000 people, including about 500,000 members of the labor force, migrated from the Valley region in the last three decades. This compares to a present population of 6.2 million. This phenomenal outmigration, also characteristic of the larger Southeast region, indicates that manufacturing and other non-farm employment did not expand enough to use the large amount of manpower available in the region -- the workers leaving agriculture and new entrants to the labor force. It also reflects the rapid growth of new job opportunities outside the region.

TVA Programs Affecting Industrialization

16. The special feature of integrated river basin projects is that a number of development activities complement each other in providing the basis for industrial expansion. For example, the Bowaters Southern newsprint mill, involving a $126 million investment, was located in the Tennessee Valley to make use of at least five different resources improved by TVA programs. The paper mill draws upon the improved valley forests for

raw materials, the new waterway to bring pulpwood to the mill, economical electric power and clean industrial water from a tributary river. Also, it is located on a site that would be flooded frequently without the protection of the TVA system of dams. Remove any of these five resources and the plant would, in all likelihood, have been located elsewhere. Furthermore, the plant expansion was greatly influenced by technical studies and technical assistance programs of TVA.

17. The key TVA programs influencing industrialization will be briefly described, but the inter-dependence of these activities must be kept in mind.

18. Physical resources development:

(a) Electric power: Power use in the Valley region increased from 1-1/2 to 63 billion kilowatt hours from 1933 to 1961. The installed capacity of the system on June 30, 1961 was about 12 million kw, and of the total power generated during the year three-fourths came from steam plants and one-fourth from hydroelectric installations. Government installation -- including two atomic energy plants, an air force engineering center, and missile and space activities -- used 44 per cent of total electric power consumption, private industry and commerce about 30 per cent, and residential users the remaining 26 per cent.

(b) Flood control: An integrated system of 31 dams controls the flow of the river system and provides nearly 15 million acre feet of storage for flood control. Thus, along the river a large and dependable supply of industrial water is available and hundreds of industrial sites have become usable.

(c) Navigation: A 650 mile navigable channel was completed in 1945 linking the Valley with the 9,000 mile inland waterway system connecting 20 states. River traffic increased from 33 million ton-miles in 1933 to 258 ton-miles in 1945, when the full channel was completed, to 2.3 billion in 1960. Coal and coke, grains, and petroleum products accounted for 86 per cent of the ton miles in 1960.

(d) Fertilizers: TVA's chemical plant at Muscle Shoals, Alabama is the nation's only large scale laboratory and experimental center for development of fertilizers. A fertilizer use and demonstration program promotes agricultural development in the Valley and across the nation. The research results on fertilizer materials and manufacturing processes have been made available on a royalty-free basis to 190 industrial firms throughout the United States.

(e) Forestry: TVA has promoted reforestration, fire protection, and sustained-yield management as support for an expanding forest products industry. The forest area in the Valley, largely privately owned, increased eight per cent in the past 26 years, and these forests contain 16 per cent more growing stock and five per cent more saw timber than ten years ago. Fire protection is now adequate on about 90 per cent of the land.

(f) Recreation: TVA has encouraged recreation use of the reservoirs through many activities which include making land available to public agencies for wildlife refuges, parks and access areas. One major industrialization effect has been the rapid growth of a boat manufacturing industry in the Valley.

19. Technical Studies and Research: Of special importance to industrialization have been TVA technical studies and research such as topographic mapping, forest inventories, minerals exploration and processing research, food processing research, and techno-economic industrial opportunity studies. TVA topographic mapping has now covered most of the river basin and the maps have become widely used for industrial development and local-regional planning. Three valley-wide forest inventories and 75 detailed county inventories have been an important stimulant for expansion of forest industries. Especially during its early years, TVA joined with the State governments to compile valuable data on mineral resources and to develop improved minerals processing methods. Food processing research, particularly on freezing techniques, gave early impetus to the establishment of canning and freezing plants in the Valley. A few techno-economic studies such as the feasibility of locating a paper and pulp mill in the Valley had great success in stimulating industrialization. In conformity with its philosophy of institution building to be discussed below, TVA's general pattern was to initiate research activities in cooperation with state and local agencies and to withdraw from the field after other agencies were prepared to assume responsibility.

20. Planning and industrial promotion: The TVA early rejected the concept of a

"planned" region in favor of the idea of a "planning" region. Consequently, neither a blueprint plan for industrialization nor for comprehensive development was ever prepared. The preferred alternative was to encourage the development of the planning function by scores of agencies and institutions in the region.[4] TVA's development success suggests that the TVA approach of a decentralized planning process rather than a master plan merits attention from the less developed areas. TVA's decision as to planning approach was influenced, of course, by almost complete reliance in the U. S. on private enterprise for industrial expansion and by TVA's limited authority for implementing an industrial plan. But even more significant was the philosophy of TVA management -- that planning and development are the democratic tasks of many institutions and countless individuals and that the maximum rate of development would be achieved by enlisting the full participation of people and institutions in the region. TVA's approach, therefore, meant a maximum commitment to so-called "institution building."

21. TVA adopted a policy of low but not subsidized electricity rates which were generally uniform throughout the region. The uniform rate policy was expected to encourage decentralization. Still another direct action was to reserve for industrial use a number of waterfront sites owned by TVA.

22. In the field of industrial promotion, an important activity in the United States and in other private enterprise economies, the TVA was severely restricted. As a Federal agency supplied with tax funds from the entire country, TVA was constantly vulnerable to political charges that it was using funds from other regions to "steal" their industries even though industrial relocation has been almost negligible in total Valley industrialization. Whatever aggressive industrial promotion activities the region chose to undertake had to develop, therefore, at the state and local government levels and through regional groupings of the TVA power distributors, all of which are municipally or cooperatively owned. And over the last decade in particular, a full range of industrial promotion techniques and agencies have emerged in the Tennessee Valley states. These non-TVA activities, ranged from special tax inducements and financial assistance to nation-wide personal solicitation of industrial firms to locate in the region.

23. Investment in TVA: The gross investment in TVA for water control and power facilities as of 1961 was $2,417 million, but the river basin projects accounted for only $836 million of the total. The remaining $1,581 million was for steam power plants, which in 1961 produced 75 per cent of total electric energy generated, and transmission lines. Total electric power, both hydro and steam plants, plus transmission facilities reached about $2,000 million or 84 per cent of the over-all TVA investment. The investment for hydro capacity on a historical cost basis averages between $120-$130 per kilowatt of installed capacity and for steam electric stations between $130-$140. The overall investment in power generation, transmission and distribution is about $200 per kilowatt of capacity. The navigation system averages about $290,000 per mile of the navigable channel.

The Over-all Pattern of Industrialization

24. A major difficulty underlying economic evaluations of river basin projects is that most governments collect their statistics by political rather than natural resource regions. Through special tabulations of census data, however, detailed industry information for the Tennessee Valley is available for the 1939 to 1958 period. This time interval covers about three-fourths of total employment gains for the region over the 1929 to 1960 period. As of 1958, the structure of the Valley's manufacturing sector differed greatly from the national pattern. The labor oriented and relatively low wage apparel and textile industries employed 31 per cent of Valley workers as compared to 13 per cent in the nation. But the chemical industry was more than twice as important in the region as the nation. This Valley industry, of course, includes atomic energy plants at Oak Ridge, Tennessee and Paducah, Kentucky. Food processing, saw mills and wood products based on the region's forest resources, primary metals and fabricated metals are next in importance for the Valley. On the other hand, the

manufacture of transportation equipment and electrical machinery rank much higher in the nation than in the Valley.

25. Growth Industries: More significant than the static picture is the dynamic growth pattern of industrialization. In terms of new jobs, the most important industries were apparel, food, chemicals, electrical machinery, furniture, primary metals, leather, non-electrical machinery, pulp and paper, and transportation equipment. These ten groups provided 80 per cent of the new jobs. In terms of rate of increase, the most dynamic industry was electrical machinery with a phenomenal gain over 1939. Other rapid growth industries in order of importance were transportation equipment, machinery, instruments and related products, rubber products, pulp and paper, furniture and apparel.

26. The industrialization pattern has differed for the various time periods. From 1939 to 1947, the World War II period, the basic materials industries of chemicals, primary metals and lumber were the leaders in expansion, accounting for almost 40 per cent of the total employment gain. In the post-war period, however, the consumer goods industries came to the fore. From 1947 to 1958, apparel and food industries accounted for 50 per cent of the employment increase in manufacturing. Electrical machinery which includes both producers and consumers goods provided another 15 per cent of the new jobs. "Value added" expanded rapidly in chemicals, primary metals and rubber products even though in the case of metals and rubber, employment showed little or no increase in recent years. This reflects continued productivity gains through heavy capital investment and automation.

27. The Spatial Pattern of Industrialization: The geographical distribution of the industrial expansion within the Valley is of special interest to proponents of rural industries and opponents of urbanization. Manufacturing activity in the Valley has continued to be heavily concentrated in urban counties. In 1959, 17 urban counties with 31 per cent of total population had 50 per cent of the region's factory workers. On the other hand, 106 rural counties with 27 per cent of the population had only 11 per cent of factory employment. Trends over the 1929-1950 period indicate considerable stability in the distribution of employment between rural, urban and metropolitan counties.[5]

Direct Industrialization Effects of TVA Programs

28. As emphasized previously, many development factors other than the TVA project contributed to the industrialization of the Valley region. Also, the development effects of the TVA project occurred in many sectors other than the field of manufacturing and in many other regions. It is precarious, therefore, to attempt to eatablish a cause and effect relationship between TVA programs and specific industrialization projects in the region. Nevertheless, as a rough estimate, the new Valley industries directly related to TVA programs accounted over the 1939-58 period for one-third of the new industrial jobs and at least one-half of the increased value added by industry. Total investment figures are not available, but because of the capital intensive nature of most of the TVA-oriented industrial expansion, it is clear that this group accounted for well over half of total new manufacturing investment in the Valley. Specific industry groups and manufactured products attracted by TVA programs are as follows:

(a) Chemicals: Industrial chemicals such as chlorine, caustic soda, sulphuric and hydrofluoric acid, oxygen, nitrogen, acetylene derivatives, sodium chlorate, hydrogen sulfite gas, titanium dioxide, titanium sponge, chemical coke; plastics; nylon and other man-made fibers; and fertilizers.

(b) Primary metals: Primary aluminum, electro manganese and ferroalloys, and copper tubing.

(c) Forest products: Pulp and paper, paperboard.

(d) Electrical machinery: Power, distribution and specialty transformers, motors and generators, instruments and electronic components.

(e) Food: Grain mills, poultry and dairy processing, animal feeds, frozen foods and meat packing.

29. The share of Valley industrialization indirectly stimulated by TVA's contribution to increased regional income is impossible to estimate quantitatively. Much

of this effect was in consumer goods industries such as apparel, furniture, shoes and electrical appliances -- categories in which considerable Valley expansion occurred but oriented primarily to national markets.

30. Several characteristics of the TVA inspired industrialization deserve special comment. The bulk of the industrialization attracted by electric power and improved water, minerals and forest resources is heavy industry producing for a national market. These resources oriented industries attracted some additional supplier industries, e.g. an alum plant was established in the valley to supply a paper mill, but few final product industries. In the case of the aluminum products industry, for example, the locational advantage is proximity to the markets rather than to primary aluminum producers. The chemicals, primary metals and paper industry plants attracted to the Valley are extremely capital intensive and employ relatively little labor in relation to the investment. Large paper mills involved an investment of $30,000 per worker; paperboard plants, $70,000 per worker; and the Calvert City chemical and electrometallurgical complex, $70,000 per worker. These figures compare with an over-all average of $8,000 per worker for all types of industrial development in the TVA area over the period from 1958 through 1961. In the early days of TVA, "rural industries" and handicraft activities were hopefully emphasized as an important source of employment for surplus workers in agriculture. However, a study of the expansion of rural industries in the Southeast over the period from 1939 to 1947 indicated that the number of jobs in rural industries expanded at a lesser rate than for all manufacturing, and that rural industries were not a promising solution to the employment problem.[6]

31. The extensive industrial complex which now exists at Calvert City, Kentucky is a dramatic and concentrated illustration of TVA supported industrialization. In the past 14 years Calvert City has grown from a small crossroads town of only 319 persons into a major industrial center with about 25 separate plants and processing units manufacturing chemicals, chemical products and ferroalloys. The plants employ about 2,000 workers and represent an investment of about $137 million. A combination of low cost electric power, river transportation and a large dependable water supply attracted the basic plants to this area. They, in turn, are attracting a number of satellite plants. TVA has a total of 270,000 kilowatts under contract to industry in this area which represents an investment in power facilities of about $50,000,000. Each industrial job, therefore, has required an over-all industrial plus power investment of almost $90,000.

Applications for the Less Developed Areas

32. The resource composition and the environment for integrated river basin projects in other areas is likely to differ greatly from the TVA situation. Nevertheless, the less developed areas can benefit by examining the different aspects of the TVA experience and by reformulating the results of TVA's thirty years of experience to fit their different circumstances. Fortunately, the TVA experience has been unusually well documented and analyzed from many standpoints.

33. Integrated river basin projects are massive investment ventures and are neither a cheap nor a quick way to create new industrial employment. But over a long period they can stimulate a significant amount of industrialization. The early planning of such projects must be integrated into national planning so that specific river basin programs will fit national development needs rather than the physical resource characteristics of the area. Furthermore, many complementary programs and projects beyond the normal scope of river basin projects are absolutely essential to secure rapid and significant industrialization results. Particularly important is the need to upgrade human and institutional resources to the point where they can make effective use of the direct results of the physical resource development programs.

34. Probably the greatest contribution of a river basin project to industrialization and economic development in general can be through regional institution building and through providing a new growth perspective to an area. An integrated river basin project as a dramatic regional venture can be an invaluable framework for mobilizing all the human and institutional resources of a region for new high levels of development. On the other hand, if such projects are not critically appraised and viewed in proper perspective they can siphon off the productive energies of an economy toward the end of "monument building."

1 Integrated River Basin Development, Report by a Panel of Experts, United Nations, p. 8, New York (1958).

2 TVA Technical Library, TVA--Symbol of Valley Resource Development, Tennessee Valley Authority, Knoxville, Tennessee (June 1961).

3 See McLaughlin, G. E. and Robock, Stefan H., Why Industry Moves South, National Planning Association, Washington, D.C. (1949).

4 Lilienthal, D.E., TVA; Democracy on the March, Harpers, (1953); Durisch, L.L., and Lowry, R.E., "The Scope and Content of Administrative Decision -- The TVA Illustration," Public Administration Review, p. 225 (Autumn 1953).

5 Friedmann, J. R. P., The Spatial Structure of Economic Development in the Tennessee Valley, University of Chicago, (1955)

6 Robock, Stefan H., Rural Industries and Agricultural Development, Journal of Farm Economics (August 1952)

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1. The Tennessee Valley Authority (TVA) project, now in its 30th year, can provide valuable guidance for the industrialization efforts of the less developed areas. Over the last three decades, the Tennessee Valley region has shifted from a predominantly agricultural area to an important and expanding industrial region. Manufacturing employment and income have expanded more rapidly in the region than in the United States as a whole. The agricultural sector, on the other hand, has followed national patterns; farm employment declined sharply and total farm income expanded at a modest rate. Due in large part to rapid industrialization, average per capita income in the Tennessee Valley increased fourfold since 1929 and by 1960 was 64 per cent of the national average as compared to 45 per cent thirty years before.

2. It must be emphasized, however, that many forces in addition to the integrated river basin project of TVA contributed to this industrialization. River basin projects are not comprehensive development programs and generally involve limited authority over many policies and activities essential to development success. Such projects can increase industrialization potentials by improving the physical availability and cost conditions of certain regional resources such as hydro-electric power, forest products, industrial water, agricultural materials and water transportation. But markets must exist for the specific resources being improved and entrepreneurship, either government or private, must be active.

3. The special feature of integrated river basin projects is that a number of related resource development activities complement each other in providing a base for industrial expansion. As one example, a large newsprint plant located in the Tennessee Valley was attracted to the region by at least five resource programs — electric power, forest improvement, industrial water, water transportation and flood control.

4. In addition to its programs for physical improvement of water, land, forest and mineral resources, the TVA also influencedindustrialization through regional planning activities, industrial process research, techno-economic industrial opportunity studies and other types of technical research. The state and local governments as well as private groups in the Tennessee Valley states have supplemented TVA programs and contributed to industrialization through a wide range of industrial promotion activities including financial assistance to new industries.

5. Specific industry types whose expansion in the Valley region have been directly stimulated by the integrated river basin program are industrial chemicals, primary metals (mainly aluminum and ferroalloys), pulp and paper, food processing and electrical machinery. In general, the new manufacturing establishments have been highly

capital intensive and oriented to a national market. In one new industrial area with a concentration of chemicals and ferroalloys plants, the investment in manufacturing plants and supporting electric power capacity averaged almost $90,000 for each new industrial job.

6. In its early days, the TVA was strongly interested in encouraging rural and handicraft industries but limited success in this direction indicates that these types of industries are not a promising solution in the Tennessee Valley for employing surplus workers in agriculture. Manufacturing activity has continued to be heavily concentrated in urban and metropolitan areas.

7. The resource composition and the environment for integrated river basin projects in other areas is likely to differ greatly from the TVA situation. Nevertheless, the less developed areas can benefit by examining the different aspects of the TVA experience and by reformulating the results of TVA's thirty years of experience to fit their different circumstances. Fortunately, the TVA experience has been unusually well documented and analyzed from many standpoints.

8. Integrated river basin projects are massive investment ventures and are neither a cheap nor a quick way to create new industrial employment. But over a long period they can stimulate a significant amount of industrialization. The early planning of such projects must be integrated into national planning so that specific river basin programs will fit national development needs rather than the physical resource characteristics of the area. Furthermore, many complementary programs and projects beyond the normal scope of river basin projects are absolutely essential to secure rapid and significant industrialization results. Particularly important is the need to upgrade human and institutional resources to the point where they can make effective use of the direct results of the physical resource development programs.

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Agenda Item: D. 2. 2

United States of America

THE INDUSTRIAL ESTATE: SOCIAL TECHNOLOGY FOR ECONOMIC DEVELOPMENT

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by

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1. Many countries are faced today with the urgent problem of industrializing expeditiously and with a sense of orderliness. The capacities of governments are taxed in finding suitable means of attaining this aim. Certain institutional devices have been used successfully to deal with the intricacies of initiating and sustaining industrial development and growth, especially as regards small and medium scale industry.

2. The industrial estate is one among several effective devices for fostering new entrepreneurship and orderly industrial expansion. It is a focal device around which other institutional means of supporting industry may be effectively deployed. Leaders in less developed countries are increasingly aware of the possibility of using industrial estates to give direction to the small and medium scale industrial sector.

Definition of an Industrial Estate

3. The industrial estate is a planned approach to the establishment of a viable cluster of industrial enterprises. The tract of land developed for the purpose must provide for the basic elements of the internal physical infrastructure, including construction of streets and roads, the installation of water, power and sanitation utilities, and the provision of transportation facilities. A comprehensive layout plan should provide for the location of all components of this infrastructure and the design of lots for the establishment of factories, parking space, and landscaping. Factory buildings may be provided also as a complete package of industrial facilities, or there may be special financial arrangements and technical assistance for factory construction.

4. An essential provision for a high quality industrial estate is sufficient future control of the developed site through such means as industrial zoning, incorporation of legal restrictions in deeds of sale or leases, and arrangements for long-term management--all with a view toward protecting the investments of the developer and the tenants.

Brief Historical Sketch

5. Industrial estates have been used with increasing success since the Second World War for promoting orderly industrialization in advanced as well as developing countries. The concept of the modern industrial estate originated in the United Kingdom and the United States less than 70 years ago. The first positive attempt to use industrial estates for industrialization objectives was the initiation of a large construction program by the United Kingdom as a means of diversifying industry in the "depressed areas" during the thirties. Large scale adoption of the industrial estate concept in the United States was stimulated by the tremendous upsurge of industry, including the establishment of many branch plants, during and since the Second World War. Today over 1,000 are in operation.

6. The British experience influenced the founding of the program in India, where today over 100 projects have been established with the specific objective of dispersing industry. In "Operation Bootstrap" of Puerto Rico, the industrial district concept of the United States mainland was adopted to achieve the twin objectives of attracting industry and achieving decentralization. There is a general and rapidly growing interest in the adoption of industrial estates. The many factors favoring the dispersal of industries in the developing countries are bound to exert a strong influence in the use of this method of economic decentralization.

7. Historically a broad range of goods have been successfully produced on industrial estates. These have included producers' and consumers' goods with the latter predominant. The mechanical and engineering industries appear in the core of emphasis in developing countries. In more industrialized countries the sophistication of markets and skills is evident, as in the electronics industry. Generally, industry is of the light and medium type, mobile with respect to markets, producing goods of fairly high value and moderate bulk.

8. In the earlier stages of industrial development, when entrepreneurship is still comparatively limited, it may be necessary for government agencies to demonstrate the effectiveness of the industrial estate concept to potential private developers. Among the obvious advantages in having private enterprise take the initiative as early as the capability can be created are the opportunities for decentralizing decision-making and mobilizing private investment capital.

9. In the United States, the typical planned industrial district, until recent years, tended to exclude ready-built factories, whereas in Great Britain and India, factory buildings are a standard provision. In addition, in India, certain special industrial and technical services are furnished to improve the productivity of tenant enterprises. Much of the success of the Puerto Rican industrial subdivisions may be attributed to the fact that factories are ready for industrialists to move in with their machinery and labor force and to begin operations.

Economics of the Industrial Estate

10. While experience with industrial estates indicates that plants of all sizes are likely to benefit from locating in such projects, the benefits appear to be greatest and most obvious for small and medium scale enterprises. The big industrial enterprise, which characteristically has comparatively large resources of finance and skilled administration at its command, can provide itself with many of the tangible and intangible elements that a small enterprise can obtain only as a member of an aggregation of firms. The economic benefits of industrial estates arise to an important degree from the following considerations:

(a) The economies of scale obtained from the overall construction, planning, and development of the project.

(b) The external economies derived from the physical infrastructure and the clustering of industrial enterprise.

(c) The economic feasibility of providing certain services and conveniences resulting from an aggregation of a sufficiently large number of firms.

(d) The benefits from a reduction of risk to the individual firm and the sponsoring authority arising from the clustering of firms.

11. Large economies of scale can be obtained from developing an industrial estate to provide facilities for a group of industrial enterprises. The major immediate benefits to individual industrialists are derived from:

(a) The assembly of land into suitable and well-located industrial sites.

(b) The construction of streets and access roads.

(c) The installation of power, water and waste disposal systems and other utilities.

(d) The easy financing of construction, particularly if factory buildings are included.

(e) The reduction in the time required to complete preparations for beginning industrial production.

12. These contributions significantly reduce the cost and promote the ease of getting into business. Industrialists benefit from the external economies which arise from association with a group of firms and from the impact on the community of an aggregation of industrial enterprises. Such benefits include the spread of technical know-how and skills among workers and management, mutual inspiration, a pool of industrial labor, and the stimulation of many kinds of entrepreneurship. The market becomes large enough also to support certain industrial services, such as common industrial facility centers and industrial advisory services. Some services may be provided by private enterprise to take advantage of the ready-made market. The concentration of industries makes it possible to establish substantial overhead facilities, some requiring heavy capital investments, such as railway and port installations or the extension of a highway system. Many services of benefit to employees and businesses, such as improved bus transportation, become feasible due to economies from the clustering of industry. In some cases, where the industrial estate is fairly large it may be advantageous to locate industrial training facilities close by.

13. An industrial estate provides the essential element of orderliness in the growth of an urban community by locating firms together in an industrial zone. It has the good effect through proper selection of industry of protecting residents from unpleasant industrial odors, noises, dangers, and traffic congestion. In the absence of a zoned approach inherent in an industrial estate, industry tends to become interspersed with other businesses and private residences because it is less costly and more convenient for entrepreneurs.

A Tool of Industrialization

14. In view of the substantial private and social benefits that arise from the clustering of industry accomplished by an industrial estate, it may be used as a positive tool for directing the process of industrialization. It is a complicated mechanism of development, and its advantages and limitations need to be properly understood.

15. In view of the comparatively large investment required, each project should be examined carefully, especially where investment capital is in short supply. Application of the principle of opportunity costs in evaluating alternative industrial estate projects in different locations and investments in other development projects or devices is therefore of major importance. An industrial estate should achieve a net contribution to industrial development.

The Institutional Framework

16. To use industrial estates deliberately as a method of promoting industrialization, a strong institutinnal framework for planning, executing, and servicing projects is essential. It may be necessary to have a hierarchy of institutions--national, provincial, and local--designed to produce a calculated long-term effect on industrialization.

17. The program should view comprehensively the integrated development of small, medium, and large scale industry. This relationship must be conceived at the topmost national planning level. Coordination is required among agencies responsible for the development of large and small industry and those in charge of planning all infrastructural investments. National planning should provide for the creation of regional industrial complexes, of which industrial estates for small and medium scale industry may be components. Such planning would enable the agencies concerned with the development of industry and those responsible for the development of the infrastructure to move in step.

18. The agencies responsible for industrial estates should be administratively strong and adequately served by investigation and planning groups. In addition, strong auxiliary measures, devices, and institutions, may be required to serve industry, including industrial advisory services, community workshops and common facilities, demonstration centers, worker and executive training programs, productivity programs, development banks, installment purchasing and supervised credit systems, cooperatives and trade associations, and research facilities. A coordinated approach using such measures simultaneously with an industrial estates program is likely to produce the best results.

Rationale for Industrial Decentralization

19. To provide the setting for industrial estates as a measure for promoting regional development, it may be worthwhile to examine the rationale of industrial decentralization. In many countries today, the fostering of industry in less developed regions is recognized as a necessary policy for political and social reasons, and governments frequently undertake decentralization even at the risk of considerable economic loss.

20. The process of economic development often accentuates existing regional disparities in income levels and job opportunities, unless positive steps are taken to modify such tendencies. For different spatial patterns of economic activity, the proportion invested in the physical and social infrastructure as compared with the investment in industry and commerce will differ markedly. Each pattern has its own special impact on the generation of further industrial growth, as well as unquantifiable social benefits and costs.

21. The comparative economics of alternative geographic patterns of development is not sufficiently understood to arrive at clear-cut conclusions. However, one might postulate a strong presumption that a country may be developed more rapidly and more economically with a decentralized pattern which makes good use of regionally distributed natural and human resources. To obtain a satisfactory development of resources and human skills, and to sustain the forces favoring democracy and political stability, it is being increasingly recognized that greater industrial decentralization should be encouraged. Where population is increasing rapidly, decentralization of economic activity should reduce the heavy migration of population from rural areas to metropolitan centers, and the economic and social costs inherent in this general phenomenon of economic development.

22. The most effective way of deliberately affecting the geographical distribution of the population is to use industry for decentralizing economic activity. The decentralization of the industrial pattern must be based upon an extension of the infrastructural system: transportation, communications, power, and water supply systems. Population will follow the redistributed industrial pattern.

The Strategy of Industrial Decentralization

23. In economic development, insufficient consideration has been given to developing regional economic complexes and to use industrial estates as components to contribute

economic viability and strength. Such complexes may be based on a nucleus of extractive industries, on the expansion or creation of seaports, inland transportation nodes, and the proximity of markets.

24. The growth possibilities of a regional industrial estate or industrial complex are greatly strengthened by branch plants of well-established large and medium scale firms from more developed urban centers. They are probably the most viable form of investment from outside, as they bring the financial and technical capacity of the parent enterprise to the new development area. Frequently they also create economic interdependence among the small and larger firms on the estate.

25. It is possible to conceive of a hierarchy of industrial estates--related to the size and industrial potential of communities--and built strategically throughout a country to maximize their economic effect. This suggests phased penetration of less developed regions on a long-term basis, say, over a five to fifteen year period.

26. The establishment of industrial complexes in the interior far from adequate transportation and utility services should be considered feasible only if there is sufficient basis for a complex of substantial scale, in view of the extensive investment required in extending the physical infrastructure to the site. Large industrial complexes make it feasible to construct the essential access roads and highway system, communication system, water and power supply and distribution systems, and sewage and drainage facilities. In addition, there is the need for residential housing projects and the social amenities provided by schools, hospitals, restaurants, hotels, and places of worship required by an integrated community.

27. A key problem in regional industrial development strategy is to establish the criteria for deciding on the rate at which industrial decentralization should be pushed. Clearly priorities will come into question as investment capital will need to be rationed for industrial development. Choices to some degree will need to be made on a locational basis.

28. The first principle in planning an industrial estate would seem to be to obtain the greatest impact in employment opportunities and dynamic growth. Secondly, it is necessary to take into account the incremental investment required in the infrastructure (particularly transportation, communications, and amenities) which is an essential and concomitant part of the overall investment.

29. The desire to assist the less developed smaller urban centers conflicts with the fact that the infrastructure essential for rapid industrial growth may be inadequate in such communities. The external economies so essential for attracting and supporting industry may not be sufficiently developed and the chances of commercial failure are much higher. Success is more likely where industry already exists; its existence indicates that external economies may be satisfactory, and that there are prospects of dynamic growth.

30. Cities with a good growth potential need to be identified for locating industrial estates. The growth rate and the ratio of industrial entrepreneurship with respect to the population is a good indication of the dynamics of growth. Large metropolitan centers with strong growth potential probably need no special assistance. On the other hand, in a whole range of cities extending down to 50,000 or less industrial estates can pay off well.

31. After a strong impetus has been given to cities in the 100,000-to-300,000 population range, it may be feasible to move on to a second tier of smaller cities and towns, ranging perhaps between 50,000 and 100,000 in population. Consolidation around the centers of strong potential should be pursued by the integration of smaller satellite cities and towns, and perhaps even large villages. Investments in very

small centers may be justified only when no larger centers with good potential exist in very underdeveloped regions.

The Size and Phasing of Projects

32. One may conceive of a wide range in the scale of industrial estate projects, with the smallest "rural" estate being perhaps one or two hectares. The scale of the project must bear some relationship to the size of the urban center and its potential for growth.

33. The amount of industrial space provided on the estate should be related to the demand anticipated over a period of years. A survey should determine the number of industrial enterprises in the community, some measure of the industrialists interested in moving to the estate, an indication of the proportion of industrialists that might be suitable candidates, an estimate of the number of new firms that might grow up in the coming years, and finally, an estimate of the number of firms that might be expected to migrate into the area. To determine actual space estimates, information is necessary on the probable size of firms and on per worker industrial space requirements.

34. Having a knowledge of anticipated demand for space, it is possible to outline a program of construction by phases, with each phase planned to keep ahead of the anticipated demand for ground space. Phased development is the most effective way of preventing over-investment in roads, factory buildings, and common utilities.

Modernization Assistance to Occupants

35. The effectiveness of the various means of assisting small and medium scale industry can be extended if intimately related to an industrial estates program. Among these, much effort should go into providing more technical know-how for the less capable industrialists. Merely to use the estate as a means of subsidizing inefficient small industrial firms is not sufficient justification, unless the means are at hand to assist the small industrialist to improve productivity in the process. In fact, the objective of modernization must begin with the selection of industrialists who have the inclination and capability to modernize and have shown a tendency to do so in their previous history.

36. Usually, it will be necessary to provide technical advice on the selection of modern machinery, for developing the plant layout, for satisfactorily installing the machinery, and for putting the plant successfully into operation. Such assistance may offer one of the most effective means of improving working conditions by providing sufficient work space to permit increases in labor productivity. On the larger industrial estates it may be feasible to have a technical group which can render assistance to a large industrial community. Lack of a properly qualified technical assistance service at the disposal of an industrial ministry of government could be a real bottleneck in executing a successful industrial estates program in an underdeveloped area.

Factory Construction Policy

37. Important problems are whether factories should be provided in advance of demand, and the financial terms and arrangements on which buildings should be made available.

38. Evidence supports a policy of constructing factories of a few standardized types, as these can meet perhaps 90 percent of the requirements of small and medium scale industry. Standardization of design has the important advantage of permitting economical construction, of obtaining acceptability from most industrialists, and of ensuring reoccupation in the event a tenant leaves.

39. Construction of some factories by the sponsor of the estate sets the tone for the types of buildings preferred and a standard which private builders may follow.

40. There are generally advantages in permitting industrialists some choices: whether to build their own factories, having the development agency construct factories to their specifications at cost, or leasing ready-built factories. They should probably have the choice of buying factories outright, buying them on installments, or renting them on a long-term basis. From the sponsor's point of view, the sale of buildings provides an effective means of drawing private capital into the project. Of course, policy must be flexible so as not to force small industrialists to sink capital into fixed assets instead of using it for operations. Buying of factories permits the creation of a revolving fund for reinvestment in phased expansion or in new projects.

Industrial Land Policy

41. Many privately financed industrial estates have been financed on a phased basis with funds obtained from the sale of developed lots. There is an increasing tendency in the United States today for developers of industrial estates to provide factories also for sale on a long-term installment basis. Control over future development is maintained through the agreement of sale and possibly through covenants which establish conditions of occupancy.

42. In India, the land, and the buildings on industrial estates, practically without exception, are rented to industrial occupants. Under the British program, land is made available to the industrial estate development authority on a 99-year lease. Ownership of the land never passes to the industrial occupants, although the factories may be sold or rented.

43. In less developed countries, where population density is high and it is difficult to acquire land, there may be good reasons for the government to retain land ownership. The community can thus capture the capital gains from rising land values that have accrued from the growth of the community. On the other hand, the incremental gain from the rise in industrial property values enhances the capital available to industrialists for further expansion.

Research for Planning Industrial Estates

44. Every industrial estate requires a feasibility study to evaluate the project from economic and engineering points of view, including the goals of the industrial estate program, and the anticipated contributions to the overall economy. Most of the limitations of industrial estates are the consequence of improper planning. The danger is that over enthusiastic expectations unbuttressed by the facts needed for making good plans may result in highly expensive industrial monuments which would divert resources from more productive investments. The overriding aim should be to establish firms in a position to be competitively viable. Therefore the location and the design of all aspects of the project need the most careful attention.

45. There is a need to decide on the regional location. There should be an evaluation of alternative sites within the urban area and the environs where the project is to be established, from the standpoint of cost, access to transportation, availability of raw materials and markets, adequacy of water and power supplies, community facilities, and the like.

46. Reference has been made to the selection of the city on the basis of its potential. There is also need for an evaluation of the probable impact of the investment on the growth of the community; and alternative centers need to be compared if a choice is to be made between communities. The choice may be affected by the type of industry it is desired to promote within the framework of a national development plan.

A survey of the industry of the area is probably essential for understanding the industrial structure, the kind of industry which may locate on the project, the state of the technological art, and what steps need to be taken for modernizations.

47. Information on space utilization in the industry is essential so that proper planning may be done and production conditions improved. Knowledge of the capital invested in land, buildings, and machinery is required to get some idea of the financial accomodations needed by industry.

48. For planning, it is desirable to know whether factory buildings are generally owned or rented. It is essential to determine if the potential tenants now located in slums or elsewhere will have the capacity to pay the purchase price or rent necessary to reimburse the development cost of the project, and the terms that industrial tenants will be able to meet. A study of the rent-paying capacity of tenants will indicate whether a project can be constructed and facilities made available on a competitive basis with industry in established industrial areas. This kind of information is invaluable for properly designing the layout of basic installations and in planning a flexible approach in the provision of facilities. In recent studies it has been shown possible to provide new factory buildings on a modern estate to cover the economic rent at rentals now being paid in nearby slum areas. Studies have shown that projects can be established on a viable basis without subsidization if physical facilities are carefully designed and policies are tailored to meet the special requirements of industrialists.

49. It is important to determine what proportion of the lots on the estate may be covered by factory space for production and storage purposes. Projects must be designed consistent with community ordinances. In some cases, amendments may be essential to introduce orderliness and to improve space utilization in the factory and in the community at large. A knowledge of existing space utilization is necessary as a basis for suggesting reasonable improvements and standards in the arrangements of space in the new estates. Setbacks and space for car parking must be adequate. By these devices it is possible to have the industrial estate add a pleasing appearance to the community and improve the conditions under which people work. It is evident, that the provision of a park-like atmosphere introduces some extra costs; therefore, some compromise is necessary between overall efficiency in the utilization of space and the provision of pleasant and convenient conditions for the operation of industry.

The Use of Industrial Estates in Foreign Investment

50. There would appear to be an opportunity to use industrial estates as a mechanism of industrial development in connection with private foreign investment and in rendering foreign economic assistance to less developed countries. The successful establishment of several excellent industrial estates in Canada by certain British firms, for example, demonstrates the possibility in the field of private foreign investment. Under the foreign economic assistance program of the United States Government to the developing countries, several pilot industrial estates are being established as demonstration projects. Foreign exchange is made available in some instances for imported machinery required by small scale industrialists established on such projects. The International Development Association (affiliate of the International Bank for Reconstruction and Development) is considering low interest loans on several projects in less-developed areas. These efforts toward using industrial estates for facilitating foreign investment in promoting industrial growth are clearly still meager, but the advantages that exist provide cause for some optimism.

51. Through the clustering of industry the industrial estate makes it feasible to invest from abroad in small and medium-sized enterprises by the reduction achieved in the administrative burden involved in larger scale equity or lending operations. The risks can be spread among many enterprises. They can be reduced further by ensuring that adequate technical assistance and superior management are built into each

project. Thus, the administrative costs involving the transfer of a large block of capital (usually the case in international loans and investments) are greatly reduced. Finally, it permits real control over the inherent economic risks by introducing necessary technical and managerial assistance.

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ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: D.2.2

United States of America

THE INDUSTRIAL ESTATE : SOCIAL TECHNOLOGY FOR ECONOMIC DEVELOPMENT

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

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THE INDUSTRIAL ESTATE - SOCIAL TECHNOLOGY FOR ECONOMIC DEVELOPMENT

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1. Experience over the past decade supports the view that industrial estates can be a powerful method of fostering industrial development. While the most extensive experience exists in North America and the United Kingdom, a good demonstration of the development possibilities of industrial estates is underway in the large Indian program. Many other countries are now initiating industrial estates programs. There is a growing tendency to use industrial estates with the objective of furthering regional industrial dispersal as many economies are being faced with economic and political problems resulting from disparate regional income and living conditions.

2. In addition, of course, good economic reasons buttress the utilization of industrial estates for purposes of industrialization. The clustering of many firms on an industrial estate is the basic principle on which the economic advantages of this mechanism for development is founded. Economies of scale in the development of such a project are very substantial in many aspects, including procurement of a suitable tract of land, and the provision of land improvements, roads, utilities and possible factory facilities. Individual industrial occupants benefit directly from the acquisition of more economical facilities, a reduction in time required to enter the business, and a more suitable industrial location. Significant external economies are an indirect benefit to the industrialist obtainable in such advantages as better transportation facilities, availability of industrial services, easier financing of the physical facilities and equipment, and possibly easier access to technical assistance.

3. Urban communities acquire social benefits from the automatic zoning of industry achieved by industrial estates, and the more orderly process of urban growth derived from their use. From a national viewpoint, the advantages appear to be several. Industrial estates permit a more manageable administration of the process of industrialization particularly of the small and medium scale industrial sector where the need to handle a mass of industrial firms represents a major administrative problem. By managing the location of large clusters of enterprises instead of individual firms, the location of industry can be controlled and directed more in accordance with community and national interests. It is on this account that there has been a growing use of industrial estates for decentralizing industry to less developed regions. The opportunities of doing this effectively are probably greater than realized, especially if the idea of integrating them into the founding of regional industrial complexes is more fully appreciated. On the other hand, there are real economic dangers of extending industrial estates too soon or on too large a scale particularly if the physical infrastructure and social amenities are insufficiently developed to attract branch plants and new entrepreneurship.

4. This last problem suggests the fact that the industrial estate cannot be considered a complete device for industrialization despite its many excellent features. It is a key mechanism but other essential services required by industrialists must be integrated with it--financing, technical services, and the training of personnel, among others. Moreover, the industrial estate should be used for the modernization of industry in the process of moving it from the slums to better facilities, by using the opportunity to raise it to a higher technological level of operation. Unless this is done, considerable unnecessary investments could be made in brick, mortar, and steel without concomitant improvements in industrial productivity.

5. Finally, there is the promise that industrial estates may be used in facilitating private foreign investment to the small industry sector. This possibility of reducing the administrative overhead and risk while transferring large investments is a tremendous advantage. It may also be applied in the administration of foreign aid programs as well as international loans where the same problems are involved in dealing with small and medium scale industry.

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CONFÉRENCE DES NATIONS UNIES
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DANS L'INTÉRÊT DES RÉGIONS PEU DÉVELOPPÉES

Point de l'ordre du jour : D.2.3

France

CONSIDERATIONS SUR L'ADAPTATION PROGRESSIVE A L'ECONOMIE MODERNE, DE PAYS A STRUCTURE ARTISANALE

Par M. DOLLFUSS

Les mémoires rédigés à l'intention de la Conférence des Nations Unies sur l'application de la science et de la technique dans l'intérêt des régions peu développées sont des documents de travail. Ils sont publiés tels qu'ils ont été présentés et les assertions et opinions qu'ils contiennent sont celles de leurs auteurs.

NOTES

1. Les mémoires choisis pour être présentés en séance générale pourront être obtenus à la Conférence dans les langues officielles suivantes des Nations Unies: anglais, espagnol, français et russe.

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CONSIDERATIONS SUR L'ADAPTATION PROGRESSIVE A L'ECONOMIE MODERNE, DE PAYS A STRUCTURE ARTISANALE

par M. DOLLFUSS

CONSIDERATIONS GENERALES

Il est à craindre que, dans des régions peu développées économiquement et traditionnellement artisanales, l'implantation de complexes industriels très modernes, dont les prix de revient se situeraient au niveau des prix européens, et dont la productivité , et donc les besoins de main d'oeuvre, seraient de même ordre que ceux des usines modernes européennes, constituerait une erreur néfaste au point de vue sociologique, en négligeant une progressivité prudente d'adaptation de la population de telles régions à l'industrie moderne.

Les expériences nombreuses faites dans ce domaine mettent clairement en évidence les inconvénients constatés. Ceux-ci peuvent se résumer ainsi :

- Exode de populations villageoises à structure familiale ou tribale vers des centres urbains industriels avec perte du caractère local et remplacement par un type de prolétariat sous-alimenté.
- Difficultés de logement de cette main d'oeuvre transplantée et naissances de zones antihygéniques, de bidonvilles, etc...
- Apparition d'un climat social mauvais avec risques de politisation naissant d'un mécontentement explicable.

Il y a donc lieu d'étudier les moyens d'obvier à cet état de choses et les solutions en découlant.

On passe en effet sans transition d'une civilisation artisanale que nous avons connue il y a 100 ou 200 ans à une civilisation du type américain, mais que les Américains eux-mêmes ont atteint après plusieurs décades de tâtonnement. Dans ce brusque bouleversement, si le rendement industriel trouve son compte (et ceci reste encore à prouver), la personnalité humaine n'y trouve certes pas le sien.

Comme il est impossible de concevoir que ces populations demeurent dans l'état presque féodal actuel, il faut les aider à atteindre un standard plus élevé, sans heurt et progressivement.

L'industrie textile se prête particulièrement à une expérience de ce genre. Il n'est toutefois pas question de revenir "au rouet de Gandhi" qui ne résout le problème que par la stagnation.

La mise au point d'un système mixte mi-industriel, mi-artisanal, constituerait, dans cet ordre d'idées, une expérience intéressante. Il y a une centaine d'années, du reste, il existait en France de nombreux industriels tisseurs qui se chargeaient de la distribution des matières et du travail à des artisans en chambre, du regroupement, du traitement et de la vente du produit fini. Il en subsiste encore quelques-uns dans certaines régions.

Ce processus industriel constitue la transition que nous recherchons et que nous pouvons améliorer en profitant des progrès qui ont été faits depuis lors.

Exemple d'un système semi-décentralisé

Le schéma ci-joint indique l'implantation d'une industrie de ce genre. Nous avons choisi l'exemple d'une filature - tissage et traitements de tissus, mais l'exemple n'est nullement restrictif.

Les installations de nettoyage, cardage et préparation de la filature nécessitant des machines à grosse production, seront nécessairement centralisées. Il en est de même des installations de préparation des chaînes pour le tissage, ainsi que celles des traitements des tissus : blanchiment, teinture, éventuellement impression, nécessitant une consommation relativement importante de vapeur.

Par contre, les opérations proprement dites de filature et de tissage, mettant en oeuvre des unités de production peu encombrantes et de faible production, leur décentralisation ne pose guère de problèmes.

Au point de vue répartition de la main d'oeuvre dans l'exemple choisi, (voir tableau de marche) on voit que si le Centre peut faire travailler 40 à 50 ouvriers, les ateliers familiaux en emploieraient 3 à 4 fois plus - ce qui est appréciable pour la création d'emplois, problème de base pour de nombreux pays en voie de développement.

CENTRE DE LA CELLULE

Ce Centre a pour missions :

1) L'achat des cotons.
2) La préparation des mèches de filature et sa distribution aux ateliers familiaux, le ramassage des filés, la paie des fileurs et la comptabilité des filés.
3) La préparation des chaînes de tissage et leur répartition chez les tisserands en chambre, ainsi que le ramassage des tissus écrus, la paie et la comptabilité.
4) L'entretien du matériel des cellules familiales. On peut concevoir que les camions de distribution et de ramassage soient agencés pour contenir également des pièces de rechange. Le chauffeur serait chargé aussi du règlage et de l'entretien des métiers.
5) La teinture, le blanchiment, éventuellement l'impression et la vente des tissus finis.

ATELIERS FAMILIAUX

Ils seraient, soit construits dans les matériaux indigènes, soit constitués par des baraques préfabriquées.

a) Pour la filature, on peut concevoir des ateliers de 2 continus de 120 broches, anneaux de 50 mm de diamètre (poids de la bobine environ 120 grammes).

b) Pour le tissage, les ateliers seraient équipés de 6 ou 8 métiers d'un empaignage courant de 125 cm.

a) Les continus à filer seraient extrêmement simples. Laminage à simple manchon (étirage 12 environ). Les machines seraient monoblocs pour éviter des montages, démontages et réglages trop méticuleux. On peut penser les attaquer avec des moteurs de 3 CV.

b) Les métiers à tisser seraient des métiers ordinaires, à navettes, assez grands, avec ou sans régulateurs. Les baraques doivent être prévues pour enlever facilement les chaînes d'ensouples ou les pièces de longueur à remplacer. Elles comporteront quelques broches de cannetières. Les moteurs électriques seraient de 1 CV.

Ces baraques pourraient comporter, suivant les climats, une installation rudimentaire d'humidification et de chauffage.

EVOLUTION TECHNIQUE ET INDUSTRIELLE

On peut prévoir que les perfectionnements apportés aux continus conduisent assez rapidement à grouper le matériel en plus grandes unités de production. Mais cette évolution ne modifie pas fondamentalement le principe de la solution, elle en accélère simplement le déroulement.

Par ailleurs, rien ne s'opposerait à ce que la cellule initiale se développant, elle tende à devenir une usine, la population ayant eu la possibilité de s'installer correctement dans les environs du centre et de s'adapter à une vie semi-urbaine.

Enfin rien ne s'oppose à ce qu'à un stade approprié de l'évolution industrielle du Pays et sans pour autant porter préjudice au fonctionnement et même au développement de l'équipement semi-artisanal ci-dessus défini, des usines de type européen soient créées et qu'elles se développent normalement. Mais à ce moment la main d'oeuvre aura été formée, des éléments susceptibles d'encadrer cette main d'oeuvre se seront dégagés et le logement aura pu être assuré dans des conditions normales.

La phase délicate de l'industrialisation aura été ainsi franchie sans imposer à la population des souffrances excessives et sans avoir bouleversé la structure sociale du Pays.

EVALUATION DES DEPENSES ET DU PERSONNEL NECESSAIRE

Exemple : Filature de 10.000 broches pour un Ne 28 pour tissage de cretonnes. L'estimation ci-après porte sur du matériel d'occasion dont des disponibilités existent sur le marché. Rien n'empêche de monter dans ces centres du matériel classique neuf. Dans ce cas, le coût de l'installation, pour le matériel seulement, serait de l'ordre de 2 à 2,5 fois plus élevé.

		Bâtiments	Matériel
Centre de la filature	(5.000 m2 à) (25.000 f/m2)	125 millions	80 millions
84 continus		-	84 "
42 ateliers familiaux	48 m2	30 "	-
Centre de préparation de tissage		25 "	18 millions
300 métiers d'occasion ordinaires		-	45 "
50 ateliers familiaux	70 m2	50 "	-
100 broches de cannetière		-	6 millions
Traitement des Tissus		25 "	25 "
		255 millions	254 millions
Total :		509 millions	

EVALUATION DU PERSONNEL (pour un travail de 10 heures/jour)

Centre préparation filature	25	
préparation tissage	15	
traitement des tissus	15	
Total du Centre :	55	55
Ateliers familiaux filature (42 ateliers à 1 ouvrier	42	
Ateliers familiaux tissage (50 ateliers à 3 ouvriers)	150	
	192	192
		247
Cadres, moniteurs, chauffeurs mécaniciens		13
		260

Si l'on compte une moyenne de 5 personnes par famille, la cellule totale pourrait pourvoir à la subsistance de 1.300 personnes. Sur ce total 192 foyers resteraient implantés sur les lieux d'habitation habituels. Le Centre proprement dit serait implanté, dans toute la mesure du possible, au centre d'un district qui comporterait un minimum de 68 foyers, groupés à proximité de l'emplacement choisi pour le Centre.

-:-:-:-:-:-:-:-:-:-:-:-

FILATURE A STRUCTURE MI-INDUSTRIELLE, MI-ARTISANALE

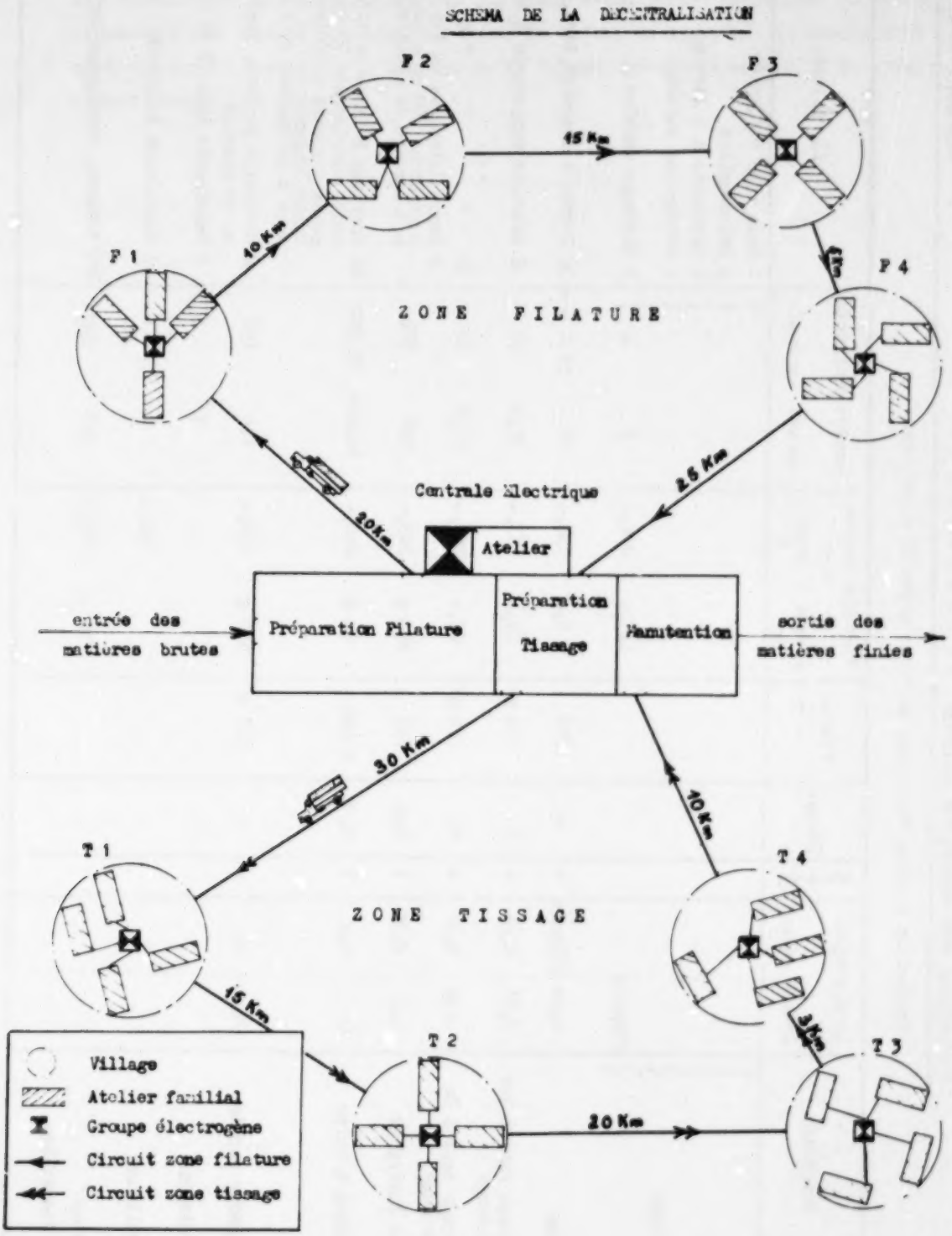
Date: 24/2/1959

Tableau de marche d'une cellule mixte

coton : Amérique

Production horaire en numéro métrique moyen 28 = 240,-kgs.

Machines	N° métrique sortant	N° métrique entrant	Doublage	Etirage	Vitesse t. p. m.	Production pratique en 1 heure p. organe kg	Production pratique en 1 heure totale kg	Nombre d'organes calculés	Nombre d'organes proposés	Composition
Battage	400gr/m					145,-	274,-	2	2	1 Chargeuse à déchets 4 Brise-balles 2 Ouvreuses à 1 section 1 Nettoyeuse inclinée 2 Batteurs doubles
Carde	0,24	400gr/m	-	-	170	5,-	258,-	51	51 + 5 =	56 Cardes à chapelet, larg. 950 mm
Etirage rapide 1er passage	0,24	0,24	6	6	110 m'	22,-	256,-	11,6	12	6 Etirages rapides de 2 têtes
Etirage rapide 2e passage	0,24	0,24	6	6	110 m'	22,-	256,-	11,6	12	6 " " " 2 "
Banc Intergros	2,2	0,24	1	9,2	750	280 g	249,-	890	922	8 Bancs Intergros de 116 broches écartement 200 mm - Laminage à 3/4 rangs de cylindres
Continu à filer	28	2,2	1	12,7	8.000	24 g	240,-	10.000	10.080	84 Continus à filer de 120 broches, écartement: 75 mm, anneaux diamètre intérieur 50 mm tubes longueur 250 mm - Laminage à un manchon en 1 zone
Bobinoir rapide	28	28	-	-	600 m'	980 g	120,-	124	140	2 Bobinoirs rapides, type BH 11 de 70 broches
Ourdissoir								1	1	1 Ourdissoir type OH 41
Encolleuse							120,-	1	1	1 Encolleuse à tambour
Métier Cannetière						790 g	240,-	300	300	300 Métiers, empeignage de 125 cms


SCHEMA DE LA DECENTRALISATION
F 2
F 3
15 Km
F 1
10 Km
F 4
ZONE FILATURE
Centrale Electrique
Atelier
20 Km
25 Km
entrée des matières brutes
Préparation Filature
Préparation Tissage
Manutention
sortie des matières finies
30 Km
10 Km
T 1
T 4
ZONE TISSAGE
15 Km
3 Km
T 2
T 3
20 Km
Village
Atelier familial
Groupe électrogène
Circuit zone filature
Circuit zone tissage

1669 F - Nov. 1962 - 1,000

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

E/CONF.39/D/177
SUMMARY
23 Nov.1962
ENGLISH
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SUMMARY

Agenda Item: D.2.3

France

GENERAL THOUGHTS ON THE PROGRESSIVE ADAPTATION OF A NATION OF CRAFTSMEN TO A MODERN ECONOMY

By M. DOLLFUSS

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

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GENERAL THOUGHTS ON THE PROGRESSIVE ADAPTATION OF A NATION OF CRAFTSMEN TO A MODERN ECONOMY

1. Industrialisation

   Difficulties - risks - progressive adaptation - learning by experience.

   Opportunities offered by the textile industry in preparing a country for industrialisation.

2. Methods of application

   Effective employment of local manpower, without involving long journeys.

   Achievement of competitive cost prices according to the products manufactured.

   Establishment of co-operatives and, eventually, of a balanced overall control.

   Solution of the progressive financing of industrialisation by the creation of co-operatives.

3. Anticipated results

   Development of consumer markets as a result of the increased purchasing power of the people.

   Comfort provided by electrification and water supply.

   Creation of industrialised cells of craftsmen capable of producing industrial factories.

   Extension of industrialisation to other branches.

   Creation of social services, based on the industrial cells.

4. Incorporation of the new economy into the traditional one

   Specialisation by the craftsmen's cells in the manufacture of simple products.

   Protection of the market against articles produced in cheap-labour countries.

   Channelling of the purchasing power created by industrialisation towards :

   the development of the country; and

   the purchase of products from the more developed countries.

S - 1669 E - Nov.1962 - 1,600

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12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item : D. 5

United States of America

THE ROLE OF THE FOREST PRODUCTS INDUSTRY IN ECONOMIC DEVELOPMENT

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Tacoma 3, Washington

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THE ROLE OF THE FOREST PRODUCTS INDUSTRY IN ECONOMIC DEVELOPMENT

by
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1. The occurrence of forest cover of some kind is almost universal. It is now recognized that the precise species available is not of major importance. Because of the great variety of possible products and the wide choice of process steps, almost any species can be put to profitable use.

2. There are some who fear that the use of wood is declining and that it may come to an ignominious end in the not distant future. What they are really thinking about are some contemporary products made of wood, not wood itself. Some products decline, others taking their places, grow. But the commodity, wood, is used in ever increasing volume. There is no evidence to support the fear that wood use will decline.

3. The tree farm concept of sustained yield and crop harvest in perpetuity rescued the forest products industry from an existence strongly flavored with expediency, and gave it instead long-range planning, orderly development, and a favorable climate for investment.

4. The objective of this presentation is to make clear and convincing the unique contribution which any forest can make to the economic development of a community, large or small, and to define certain guidelines which are essential to the success of this development, particularly in the area of complete and integrated utilization of the forest crop.

Multiple Uses of Forest Products

5. The most important broad uses that are made of manufactured forest products are in:

(a) Serving construction, both structural, functional, and decorative.
(b) Serving transportation, from the irreplaceable railroad tie at one extreme to the decking of ships at the other.
(c) Providing the necessities of living: the millwork, the cabinets, the counters, the wardrobes, the closets, and so on.
(d) Providing the comforts of living: the paneling, the furniture, the flooring, the insulation, the sound deadening, and so on.
(e) Serving communication: the spoken, written, and printed word.
(f) Providing shipping containers and their accessories of all kinds from the little egg carton of perfect performance to the huge modular transferable crates or bins.
(g) Providing the pleasures of living from the gun stock of the sportsman to the grand piano of the artist.
(h) Providing the paper products for healthful living, and
(i) Contributing to the great areas of films, filaments, textiles, finishes, explosives, soil mulches, concrete additives, well drilling aids, adhesive extenders and others.

Diversity of the Forest Products Industry

6. Only when one attempts to list all the markets for and the uses made of forest products, does one realize how greatly diversified the industry is. This diversity, however, can be broken down into three major categories of forest products: solid wood, fibers, and chemicals.

7. Solid wood takes many forms: Round piles, poles, and posts; sawed lumber of many varieties; sawed timbers larger and heavier than lumber; millwork engineered to specific uses; laminated lumber as structural members; plywood serving an entire panel-using world of its own; sawed or split shingles and shakes; and finally sub-divided whole wood running the gamut from wood wool through shavings and flakes to sawdust and wood flour.

8. Fibers, from whole wood to all-cellulose, also take many forms, their variety being such as to force one to be arbitrary in attempting any all-inclusive classification. Wood fibers cannot be prevented from felting and their great utility depends upon this felting action. Among these fiber products now on the market, exclusive of paper or paperboard, are low density mats and blankets for packing, padding, deadening sound and restricting heat transmission; insulation boards providing decorative and acoustical ceilings; sheathing, roof decking, and sidings; and finally hardboard, which is currently undergoing a change from commodity to engineered product reaching for additional markets through improved hardness, smoothness, durability, and visual appeal.

9. With respect to the ramifications of paper and paperboard, the differentiation between the two is largely a matter of thickness. The variety of materials used runs the full range from reclaimed waste paper through mechanical pulps or groundwoods, high-yield chemical pulps to full chemical pulps unbleached, bleached and purified. There are papers well standardized in appearance and performance, e.g., newsprint containing a high percentage of mechanical pulp, and such strong all-chemical pulp papers as kraft liner, kraft bag, and kraft wrapper. Huge investments are required for this aspect of the paper industry since these products serve big tonnage uses and their producing mills are large and of high cost per daily ton of capacity.

10. The more than a million tons of chemical cellulose produced annually for conversion to filaments, films, lacquers, and explosives is the outstanding commercial accomplishment in chemicals from wood. Although this is over-simplification, we may take wood apart gently, or we may break it up by rough treatment into chemical pieces. Broadly we may attempt this in four different ways: The first is fractionation or extraction, an ideal method to employ in which the severity of treatment is kept to the minimum required to accomplish the separations. The second may be called cleavage, whereby the lignin is rendered soluble by delignification, leaving the cellulose insoluble; or the cellulose is made soluble by conversion to sugars by hydrolysis, leaving the lignin insoluble. The third approach makes almost everything soluble by hydrogenation. The fourth approach produces a mixture of solids, liquids and gases by pyrolysis. All four of these techniques continue under development in the U.S. and no doubt in other countries also.

11. Sound economics require that chemical use be centered in conversion of all of a given raw material into valuable products. Those who continue to discard a substantial portion of their raw material as waste are not showing sound judgment.

Establishment of a Forest Products Industry

12. In planning for the establishment of a forest products industry there are a

number of factors that need to be taken into consideration. First consideration should be given to the possible markets for the products, the availability of raw materials, and the requirements of use. If these appear favorable, then consideration should be given to such matters as practical technology, sound economics, capital, right timing, and provisions for renewing the forest resource.

13. Any specific business originates in the markets and the uses it serves. These govern the nature of its products, the products in turn control their production, and the process steps and corresponding equipment are chosen to convert economically the available raw material to the product desired. Hence, choice of market, uses and products come first; second is choice of raw material, depending on the forest inventory, sustained yield and delivered cost species by species; third, choice of the process steps to connect the raw material to the product; and fourth, the choice of equipment to execute the process steps.

14. The choice of the raw materials to be used depends to a great extent on taking advantage of unique superiorities exhibited by some one of the species, both product- and process-wise. The scope of practical technology encompasses both the process steps and the equipment to carry them out.

15. Both industry and government have paid much too little attention to the requirements of use. The requirements of use control the property values of the product; they control its satisfactory performance in use, and thereby its price level, both absolute and relative to competition; and finally its very business existence. Therefore, before we plunge into commercialization, the facts of performance must be developed. These are some suggested steps:

(a) Record the use requirements involved in ordinary nontechnical terms. This describes what the product must do.
(b) Select the corresponding product properties.
(c) Establish adequate methods of test for each property.
(d) Prepare an ideal specification.
(e) Modify the ideal to a technically and economically practical specification.
(f) Measure product performance. This describes what the product must be.

16. We therefore observe that there are two performance yardsticks -- one absolute based on use, the other relative based on competition. The foregoing sequence is called the use requirements technique, and before it is attempted a thorough market survey should be made.

17. The technology to be practical must either have been practiced elsewhere or have gone through pilot plant studies successfully. It must not be too complicated, yet adequate for the job to be done. It should provide ease of control. It should lend itself to the application of continuity of manufacture, and should be amenable to developing manufacturing costs which allow production to reach its profit objective.

18. The most often encountered stumbling block to successful commercialization is that of sound economics. One cannot help but marvel at the number of projects going into commercialization without any serious attempt at an operating forecast. This forecast merely determines net earnings after taxes by subtracting all expense from net sales income in as simple and logical a manner as possible.

19. A definition of sound economics in this instance might include the following: Enough volume of goods bringing a sufficient price in the competitive market place;

to furnish a profitable income; to provide workers with the necessities and some of the luxuries of living; to pay direct and indirect manufacturing costs, including those for replacement of equipment priced at more than the depreciation reserve; to provide for normal company growth; and to finance a fair share of governmental functions while still maintaining enough earnings to pay as much for use of the funds invested in the enterprise as could be obtained otherwise on an equal risk basis.

20. In connection with the capital requirements per unit of production capacity, there is great leeway in the case of wood to choose the extent to which the traditional simplicity of process steps and equipment shall be enjoyed as compared with the more complicated contemporary techniques.

21. Right timing is often overlooked. It is a hard lesson to learn. Regardless of how attractive the market may be, how practical the technology, or how sound the economics are, there must be good justification for attempting commercialization -- justification which has its genesis usually in a real need. One often hears of the inventor who was ahead of his time. His timing was wrong. The semichemical pulping process went into the first pulp mill about 1930. The process slept peacefully until 1945 when it was suddenly awakened owing to the realization that it would permit cheaper species to be used for pulp and paper. Advent of the compression barker was inadvertently timed perfectly, since a great need existed for a barker of low capital and operating cost.

The Tree Farm Program

22. The fact that forests are a renewable resource should be recognized, of course, in planning for a forest products industry, and the whole program should be structured on this important asset.

23. It has now been recognized that forest cover is not an inexhaustible resource and that nature alone cannot be expected to replace the timber that man has harvested. Nature can supply the seeds but unfortunately, as in the case of the conifers, rodents find these very tasty, and when the relatively small number of seeds that survive produce seedlings the ruminants come in to feast on the succulent plants. Electrical and wind storms, likewise, take their toll. Thus, man's help is needed.

24. The tree farm concept came into being as a means of helping nature replace the trees that are harvested or destroyed, and thereby insuring an adequate future supply of lumber. Basically, it involves a series of measures which when properly applied provide the reforestation required. One of such measures is to coat the tree seeds with a repellant that is distasteful to rodents. The coated seeds are then spread over a denuded area by helicopter. Another is to establish large tree nurseries to grow seedlings for transplanting. Different practices are followed for the various species. In the case of ponderosa pine, for example, the modern practice is to harvest the tree crop by a thinning out process and then to replace the cut trees with seedlings. The result is a whole forest of trees at various stages of growth. The douglas fir seedling, on the other hand, is not able to survive under such conditions since it does not thrive in the shade, and the accepted practice, therefore, is to completely clear the various plots where the trees have reached maturity, and then spread seeds over the area by helicopter, or transplant seedlings. In any case, the young seedlings require careful attention so that those damaged by ruminants, or by other means, can be replaced. Also, the whole forest area must be inspected periodically for diseased trees and these should be promptly removed to avoid having the disease spread and ruin the forest.

Integrated Utilization of the Forest Crop

25. If we are to enjoy the unique opportunity wood gives us to benefit by integration, then we should plan against a background of complete utilization of the tree farm crop. This in turn means building an industrial complex, gradually certainly, starting modestly, and proceeding soundly as the integration expands.

26. In forest products, our first concern is to utilize the whole log and when this has been accomplished, then the whole tree harvest and finally the whole tree farm crop. Common sense tells us to give highest priority to the integrated utilization of the whole log as brought to the mill.

27. It is axiomatic that whole log use can be successful only to the extent that markets and uses consume huge quantities of products. That any such markets could be found for mixtures of such different materials as wood and bark is certainly remote. Then, regardless of the ultimate products, these two constituents must be cleanly separated, wasting neither one. Until 1950, saw log users had been unconcerned about the barking process; plywood producers chewed the bark off of their so-called peeler blocks along with a substantial percentage of clear sapwood.

28. The pulp makers for years had accomplished their barking of small logs by manual woods peeling or by the use of huge drums at the mill. Later they employed hydraulic barkers for both small and large logs giving bark-free wood, but not wood-free bark. These hydraulic barkers were so expensive in first cost and operating cost that their use in any but the largest operations could not be justified. This was the situation which demanded an answer, especially one within the ability of the small operator to finance. A number of approaches to an answer to this question have been attempted in the last decade, and the answer now seems definitely in hand, namely, continuous mechanical barking at the mill.

29. Sparked by the desire to achieve bark-free logs and in turn, if possible, convert wood-free bark by a dry process to useful products, the Weyerhaeuser Company began to explore the possibilities of dry log barking in 1945, at that time for application to peeler logs. The first barker of this type was put into successful operation in in 1947 in the then new plywood plant of Weyerhaeuser and furnished "as is" bark to a new bark utilization plant which went into operation that same year. Since that time this basic principle of compression and shearing at the cambium layer has been employed in many designs of log barkers, with a cost well within the resources of the smaller log processors. This technique of compression barking is probably the greatest factor in accelerating integrated whole log use in the U.S.

30. Now, assuming we have bark-free wood in log form ready for processing, what key product will do most to reach whole log utilization? Since the manufacture of fiber or chemicals starts with wood in relatively small pieces, it would appear logical that solid wood products of substantial dimensions should be our first choice. This means, of course, lumber and plywood. Will lumber manufacture be a sufficiently stable and profitable business to justify the close relationship that is involved in future raw material integration?

31. The storage and handling of huge tonnages of raw material are economically accomplished even with species whose logs do not float. Fifty tons of coniferous wood is fed to the mill per hour, or a ton a minute, for the sawing of 100,000 FLS in eight hours. The reduction of the log to lumber is continuous, processing temperatures and pressures are atmospheric, no other raw materials of any consequence are required, the equipment is reliable, the performance dependable and reproducible. Labor and plant investment per unit of output are low and annual net income per capital dollar invested is attractive. These are the details which provide a stable successful basis for integration.

32. The manufacture of lumber and plywood has a unique opportunity to bring raw material integration into being. Certain it is that no cheaper hardboard, softboard, particleboard, or pulp or paper can be made than that provided by integration with the manufacture of lumber and plywood. It is believed that these solid wood products constitute the best foundation for whole log use.

33. Integration other than that of raw material depends on the details of the specific case so far as process steps and supporting equipment type and arrangement are concerned. The harvesting of marginal logs and their transportation require little change in techniques. Chipping, flaking, and screening operations are new, but the handling of masses of bulk materials is old. The servicing of the integrated operation, both from the standpoint of producing and distributing the utilities, and supplying all the administrative functions, involves merely enlarging the staff and facilities, with the opportunity to improve performance by so doing.

34. Our discussion thus far has been limited, at least by inference, to mill residuals of chippable shape and size. There are, however, many other kinds of residuals. The following listing includes all types commonly encountered:

(a) Mill Residuals - Concentrated at the mill
  Lumber
    Bark; chippable - slabs, edgings and trim; shavings - green and dry; and sawdust - green and dry
  Plywood
    "Lily pads"; bark; cores; broken and discarded veneer - green and dry; panel trim; and sander flour

(b) Logging Residuals - On the ground
    Tops; branches; chunks, - large diameter short length pieces; toothpicks, - small diameter shatter and knocked down saplings; and marginal logs, - crook, decay, shake and so on from felled merchantable trees, sometimes called "wood logs"

(c) Forest Residuals - Standing
    Cull trees, producing "cull logs" if felled - those of poor form and large defects; small trees, including thinnings; unwanted or unpopular species; and inaccessible trees, too costly to secure.

35. The chippable residuals have as chips many uses in the fiber field, which is well understood and widely practiced in the United States. The shavings find their outlet primarily in particleboard, although some go along with the chips. We now find it convenient to differentiate between coarse and fine sawdust, the former being usable to a modest extent in certain fibrous products. Tonnage use of fine sawdust is still a problem with the answer probably to be found in chemicals manufacture. Bark is being converted in many ways to usable commodities through both mechanical and chemical processing. Ten percent of the incoming logs cannot be wasted indefinitely, especially in view of the unique constituents it contains. In the plywood picture, lily pads, cores and discarded veneer are chippable residuals. Volume uses for sander flour are still to be found.

36. As the mill residuals earn a profit, the easiest-to-get logging residuals begin to come in with the good logs and, since these do not appear in any timber cruise, they cost only what it takes to bring them in. It is clear that the cost increases as the pieces are smaller, shorter, and farther away. So the complete integrated utilization which we seek depends not only on efficient conversion and marketing, but on less costly techniques of harvesting and transportation. As an example of the advantages of integrated use, the yield per acre from an old but

heavy stand of douglas fir was increased over a period of some fifteen years from about 40,000 feet log scale to 80,000.

Typical Commercial Integrations

37. A listing of some of the commonly practiced simple integrations is as follows:

(a) Softwood lumber production with the production of industrial wood parts, glued-up panels, prefabricated timber members, laminated structural members ("glu-lam"), chips, veneer, plywood, softboard, hardboard, particleboard, and various pulps

(b) Plywood production with production of industrial wood parts, prefabricated panels and structural members, chips, softboard, hardboard, various pulps, paper overlays, and hardboard overlays

(c) Softboard, hardboard production with hardboard overlays, paper overlays; and particleboard production with veneer overlays and paper overlays

38. A listing of some of the unusual integrations is as follows:

(a) Lumber production with the production of whole wood fiber, wet pulp molding, bark products, and carbohydrate gum

(b) Plywood production with the production of bark products, paper overlaid veneer - (2 faces), and facings of pulp

(c) Particleboard with facings of pulp

39. There are many complex integrations in the largest operations in the United States, one of which for example, based on lumber and plywood, includes lumber panelization, glue laminated members, prefabricated timber members, bark products both mechanical and chemical, sulfite, semichemical and sulfate pulps, and various grades of paper from food board to glassine.

Smallest Practical Manufacturing Capabilities for Various Forest Products

40. Approximate guidelines frequently asked for by those contemplating entering some phase of the forest products industry, usually as part of an integration are: What is the smallest practical manufacturing capacity, and what is the fixed capital investment likely to be?

41. The principal problem, even in generalizing, is to rationalize the wide differences in prices, costs, climate, availability of services, site quality, product variety, and extent of finishing operations. There are a number of well-known factors which put a ceiling on plant size. There are also others which are used to determine the minimum size, e.g. to avoid unsound economics, a size too small to integrate or a size controlled by the maximum operating capacity of a key piece of equipment.

42. It is customary in the United States to express plant capacities in short air-dried tons per day, and capital cost in dollars per daily short ton, because of the variety of units of measurement of production encountered with different products. The following table is self-explanatory:

Table 1

1 Product	2 Minimum Daily Production Capacity	3 Expressed in Units thus	4 Days per Operating Year	5 Shifts per Operating Day	6 Capacity Limited by	7 Factor to Convert 2 to short air dry tons	8 Minimum Daily Production Capacity tons*	9 Basic Fixed Investment dollars per short ton
Structural Plywood	220,00	Sq. ft. 3/8"- 30 lbs. pcf.	240	2	1 Hot Press	.00047	100	35,000
Softboard	330,000	Sq. ft ½" 20 lbs. pcf.	340	3	1 Wet Forming Machine	.00042	140	45,000
Hardboard	275,000	Sq. ft. 1/8" 64 lbs. pcf.	340	3	1 Dry Forming Machine	.00033	90	35,000
Particle-board	45,000	Sq. ft. 3/4" 40 lbs. pcf.	240	3	1 Single Opening Press 8'x16'	.00125	50	20,000
Semi-Chemical Pulp	100	Short AD tons	340	3	Defiber-ing and economics	1.00	100	25,000
Unbleached Kraft Pulp and Paper	200	Short AD tons	340	3	Economics	1.00	200	30,000

43. Lumber is omitted from the above tabulation because of the terrific variety of mill designs and sizes extending from as little as one million feet board measure (FBM) annually to as much as 200,000,000 in certain places on the West Coast of the U.S. The principle matter of interest here is the minimum size finished kiln dry lumber-mill to support integrated utilization. We may assume roughly that half of the actual volume of solid wood going into such a mill turns up as residuals and half of these are suitable for chips or flakes. One thousand FBM of U.S. West Coast douglas fir lumber shows an actual volume of about 70 cubic feet. This, at thirty pounds per cubic foot, is equal roughly to a ton of wood. Hence for every two tons dry going into the mill, one-half ton turns up as chips or flakes.

44. To tie the figures of Table 1 into the required size of a lumber or plywood mill to be the sole source of useable residuals requires knowledge of such details as usage of nonchippable residuals as well as chips for raw material; the actual distribution of incoming wood and most important weight yields from residual to finished integrated product; and days per year the mill is operated.

45. It should be emphasized that all the foregoing figures are for the purpose of initial project orientation and it is hoped they will be useful in crystallizing a course of action. They must not be used to arrive at firm and final decisions without adequate confirmation. Also, all the figures apply to the North American conifers.

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* Figures rounded off.

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: D.5

United States of America

THE ROLE OF THE FOREST PRODUCTS INDUSTRY IN ECONOMIC DEVELOPMENT

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THE ROLE OF THE FOREST PRODUCTS INDUSTRY IN ECONOMIC DEVELOPMENT

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SUMMARY

1. The occurrence of forest cover of one kind or another is almost universal. The precise species involved is not of major importance. Because of the great variety of possible products, and the wide choice of process steps, almost any species can be put to profitable use.

2. There are some who worry about a possible decline in the use of wood. What they are really thinking about are some contemporary products of wood, not wood itself. Some products decline and others, taking their place, grow. But the commodity, wood, actually is being used in ever increasing volume.

3. A unique feature of the forest products industry is the variety and magnitude of the materials produced. They consist of three major categories: solid wood, fibers and chemicals. The solid wood category includes: sawed lumber of many varieties; millwork; laminated lumber; round piles, poles and posts; plywood and plywood panelling; shingles and shakes; and sub-divided wood, such as wood wool, shavings, flakes, sawdust and wood flour. Fiber products include: paper and paperboard; mats and blankets for packing, padding and insulation; insulation boards and sheathing; and hardboards. Chemical products involve filaments, films, lacquers, textiles, finishes, explosives, soil mulches, and concrete additives.

4. In planning for the establishment of a forest products industry, first consideration should be given to the possible markets for the products, the availability of raw materials, and the requirements of use. If these appear favorable, then consideration should be given to such matters as practical technology, sound economics, capital, right timing, and provisions for renewing the resource.

5. Markets govern the nature of the end product to be produced from the available raw materials. Requirements of use control the characteristics of the product, its performance, and thereby its price level. The technology to be practical must either have been practiced elsewhere or have gone through pilot plant studies successfully. The most often encountered stumbling block to successful commercialization is that of sound economics, and an operating forecast is of extreme importance. Regardless of how attractive the market may be, how practical the technology, or how sound the economics, right timing should not be overlooked. In considering the capital requirements per unit of production, there is a great leeway in the case of forest products to choose the extent to which the classical processes shall be used as compared with the more complicated contemporary techniques.

6. The fact that forests are a renewable resource should be recognized, of course, in planning for a forest products industry, and the whole program should be structured on this important asset. The tree farm concept has brought order to the forest products industry by helping nature replace the trees that are harvested or destroyed, thereby insuring an adequate future supply of lumber. Various measures are used depending upon the species involved. One well established practice is to create large tree nurseries to grow seedlings which are transplanted to replace the trees that have been harvested or destroyed. Another practice is to spread tree

seeds over a denuded area by helicopter. The seeds are first coated, however, with a repellant because otherwise they would be consumed by rodents. The young seedlings that develop from this method, as well as those that have been transplanted from the nursery, are given careful attention, and those that are damaged by ruminants, or by other means, are replaced.

7. If advantage is tc be taken of the unique opportunity wood provides for integrated operation, planning for a forest products industry should provide for complete utilization of the tree farm crop. This means building an industrial complex, starting modestly and proceeding soundly as the integration expands.

8. The manufacturer of lumber and plywood has a unique opportunity to bring raw material integration into being. Certain it is that no cheaper, hardboard, softboard, particleboard, pulp or paper can be made than that provided by integration with the manufacture of lumber and plywood.

9. Some of the commonly practiced integrations are: softwood lumber production with glued-up panels, prefabricated timber members, laminated structural members, veneer, plywood, softboard, hardboard, and particleboard; plywood production with prefabricated panels and structural members, chips, softboard, hardboard, various pulps, paper overlays and hardboard overlays; softboard production with hardboard overlays; hardboard with paper overlays; and particleboard with veneer overlays and paper overlays.

10. Approximate guidelines frequently asked for by those contemplating entering some phase of the forest products industry, usually as part of an integration are: What is the smallest practical manufacturing capacity, and what is the fixed capital investment likely to be?

11. The principal problem is to rationalize the wide differences in prices, costs, climate, availability of services, site quality, product variety, and the extent of finishing operations.

12. There are a number of well-known factors which put a ceiling on plant size. There are also others which are used to determine the minimum size, e.g., large enough to provide sound economics, large enough to permit integration, and large enough to work a key piece of equipment at maximum performance.

13. Table 1 provides information concerning minimum plant capacities for a number of forest products and the basic fixed investment dollars per short ton that are involved. For example, a plant producing structural plywood equipped with one hot press, and operating two shifts per day for 240 days a year, would have a minimum daily production capacity of 220,000 square feet (3/8" - 30 lbs. per cubic foot), or 100 short tons, and the basic fixed investment dollars per daily short ton would be approximately $30,000. A plant producing particleboard with one single-opening press (8' x 16) operating three daily shifts for 240 days a year, could produce 45,000 square feet or 50 short tons daily with a fixed investment of $20,000 per daily short ton.

14. The figures quoted in the table should only be used for initial project orientation and should not be used to arrive at firm and final decisions without adequate confirmation. Also, all of the figures apply to the North American conifers.

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